

## INTRODUCTION

### Survey Objectives

The objective of the 1999 Study of Public Attitudes Toward and Understanding of Science and Technology was to build on nearly two decades of experience in the design, conduct, analysis, and interpretation of the public understanding and attitudes studies conducted for *Science and Engineering Indicators* and to continue to produce an accurate, high-quality, and timely report for *Science and Engineering Indicators* 2000. The terms of RFP SRS 99-002 called for the replication of the 1997 study, with a few minor variations. The 1999 study was conducted under contract from the Division of Science Resources Studies of the National Science Foundation. Professor Jon Miller served as principal investigator for the 1999 study at the Chicago Academy of Sciences. The telephone interviews included in the study were conducted by the National Opinion Research Center (NORC).

### Design Overview

The design of the 1999 Study of Public Attitudes Toward and Understanding of Science and Technology called for a replication of the 1997 *Science and Engineering Indicators* study, with only a few minor variations. Telephone interviews were conducted with 1,884 adults<sup>1</sup>. One additional question was added to the 1997 questionnaire to probe for additional information about the public's understanding of DNA (see Appendix A for the questionnaire used in the 1999 study).

## SURVEY DESIGN

### Survey Instrument Summary and CATI Development

NORC preparation for this Random Digit Dial (RDD) survey began with a kickoff meeting and discussion of the 1999 survey instrument and procedures on March 3, 1999. Study preparation ran approximately three weeks, and included programming the new version of the instrument into a Computer Assisted Telephone Interviewing (CATI) environment, selecting the sample of telephone numbers, designing the Telephone Number Management System (TNMS) for the survey, mailing out advance letters, and training interviewers to conduct the interviews.

### Changes to the 1999 Instrument

The 1999 questionnaire had several minor changes from the 1997 version and one new question regarding DNA. (See Appendix A for the English version of the instrument.) In the preamble the phrase "For quality purposes, this call may be monitored" was added in compliance with the Federal and state

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<sup>1</sup> Two respondents were dropped from the final analytic file due to non-response on critical items, leaving the final analytic file with 1,882 cases.

electronic monitoring laws. A question on “Do you have cable television?” was changed to “...cable or satellite television”.

For purposes of establishing weights for the sample, five items were designated as critical to a completed interview. Those items were: age, gender, level of education, race/ethnicity, and the number of adults in the household.

A new change for the 1999 instrument was to have it translated into Spanish. Once all hard copy questionnaire changes were agreed upon, the English version was translated into Spanish and reviewed by separate translators at NORC, and then by a translator at the Chicago Academy of Sciences. The instruments were then sent on to the programming staff for conversion into electronic versions. (See Appendix B for the Spanish version of the questionnaire.)

NORC staff estimates that the cost of the Spanish translation was approximately \$3,500, which included the translation of the instrument and scripts, a review by a second Spanish translator, text revisions, and programming costs. Not included in this amount was an additional review by a translator for the Chicago Academy of Sciences. The cost of the translation was expected to be offset by its reuse in future rounds of the survey.

## **CATI Testing and Development**

The CATI (Computer Assisted Telephone Interviewing) application, programmed by **SurveyCraft**, was completed by March 9 and a vigorous program of testing was performed. NORC programming staff, project management and telephone center staff took part in the testing activity, which resulted in some adjustments and re-testing. In addition, Linda **Kimmel** of the Chicago Academy of Sciences tested the instrument for wording changes and skip patterns.

For the SMS (Surveycraft’s Sample Management System) setup, NORC staff initiated discussions with the supervisor of SSSG (Standard Systems Support Group). Specifications for the telephone component of SMS were provided by the head of the Downers Grove Telephone Center.

For the CATI (Computer Assisted Telephone Interviewing) setup, the TQA (Technical Questionnaire Analyst) met with SOC (Survey Operations Center) management to go over the revisions to the 1997 instrument.

After the TQA finished coding the revisions into the CATI instrument, it was unit tested. Then the TQA turned over the CATI to the telephone shop supervisor and interviewers for user acceptance testing. Any issues with skip patterns or wording/phrasing were then forwarded to the TQA for correction and then retested. The random assignment feature for questions 87, **96b**, and 101 was tested. NORC staff went through two rounds of testing before the instrument was signed off by both NORC staff and CAS staff.

At that point, SSSG brought the instrument into the standard RDD (Random Digit Dial) SMS frame and released it to the telephone center for Integrated System Testing on the test side of the application’s directory.

The following tests were then conducted by the Telephone Center:

- A. Preamble screens were checked for screen fit, wording, and displayed variables.

- B. Time zones were tested to make sure that the right area codes were adjusted appropriately for geographical location (i.e. east coast numbers stop presenting at 8:00 PM Central Standard Time).
- C. The various ways the questionnaire might be broken **off** were **tested to** make sure that the disposition codes were accurately assigned.
- D. Further testing of the instrument was also conducted to **verify** that the right version was put into the SMS shell.

When all these tests were passed, NORC staff moved the instrument over to the production side and refreshed the system mocks for training.

Training was conducted in the production system to make certain that the review of the test side was identical to the instrument and SMS loaded on the production side. Mock data was used to preclude any contamination of the sample data. The TQA and SSSG were both on call during training to ensure that any unexpected issues with the production side were addressed immediately. Frequencies from the mock data were reviewed.

Final Integration Test sign-off came after the training was completed and before the actual production survey began. The TQA reloaded the production side instrument with the RDD sample and the Telephone Center started interviewing.

The TQA and SSSG then moved into a maintenance/support mode during the data collection period, periodically producing exports for the mail center to send out the postcards and **FedEx** letters defined by the client.

The CAT1 instrument had a variety of functions programmed.. For cases where an address was supplied (described below), the respondent's name and addresses were preloaded. A flag was set for a case if an advance letter had been mailed and the preamble was tailored accordingly. Requests for' additional information on the study as well as for study results were captured. Critical item designations were noted. In a post interview screen the interviewer's assessment of the level of the respondent's comprehension of questions and the level of seriousness were captured. Whether the interview was conducted in Spanish and the offer and amount of any respondent fees (described below) were also captured.

Six of the questions (questions 62, **64**, **66**, **68**, 70 and 80) called for capture of possibly lengthy verbatim responses. Because interviewers were trained to record the full response, no limits were set on the number of characters allowed by the program. The CAT1 was ready with mock cases for training and for production by March 22.

### **Population of Interest, Sample Design and Respondent Selection**

The Study of Public Attitudes Toward and Understanding of Science and Technology called for 2,000 completed cases from adults residing in households with working telephones in the United States. Persons residing in group quarters and institutions (including military barracks) were to be excluded from the study. Military personnel residing off-base were to be included in the study. A list assisted random digit dial design was implemented for the study. The sample, purchased from Survey Sampling, Inc.

(SSI), consisted of 7,200 randomly generated telephone numbers in the United States, including Alaska and Hawaii. The sample was purchased in 34 replicates with approximately 200 telephone numbers in each replicate. Thirty-two of the 34 replicates were used, for a total sample of 6,800 cases.

These sample telephone numbers were then matched by Survey Sampling, Inc. for names and addresses. This information was used for an advance letter mailing, for a mailing of refusal letters and postcards, and for respondent fees. Names and addresses were provided for 2,205 households. An initial screening out of business numbers was performed by SSI. During the data collection 817 additional business numbers were reached. For cases with names and addresses supplied by SSI, NORC performed an additional screening to verify the addresses for those households (see section on mailings).

Respondents within households were selected using the most recent birthday technique. The individual over the age of 18 with the most recent birthday was considered the eligible respondent at the number dialed. Interviews were conducted in English or Spanish, as needed.

### **Interviewer Recruitment and Training**

Interviewer recruitment for the NORC Downers Grove, Illinois, telephone shop commenced in late February 1999. Twenty-nine interviewers were hired, the majority were experienced NORC telephone interviewers. Three interviewers had previous experience with the 1997 *Science and Engineering Indicators* study. Several of the interviews also had experience with the 1998 follow-up of the General Social Survey (GSS) funded by the Office of Behavioral and Social Science Research (OBSSR) in the Office of the Director of NIH. The OBSSR study included some of the same open-ended questions that appeared in the 1999 *Science and Engineering Indicators* questionnaire. Six supervisors were recruited from among the NORC telephone supervisors. Interviewers were trained in person at the NORC Downers Grove telephone center with half of them trained on March 23 and the other half on March 24. Training was conducted by the NORC Telephone Center supervisory and coordination staff, NORC project management, and Professor Miller and Dr. Kimmel of the Chicago Academy of Sciences. (See Appendix C for a training agenda and copies of the training manual.)

Of note, recording verbatim responses according to Chicago Academy of Sciences specifications was a major focus of the training. There were a number of open-ended questions in the instrument, and interviewers were trained to prompt in specific ways and to record responses in their entirety. A spelling list of key words expected to appear in the verbatim responses was discussed and many of the words were used in the interviewers' mock interview exercises and were part of the final checkout requirements. The walk through of the instrument, including review of the question by question explanations, with background provided by the Chicago Academy of Sciences staff, received careful attention. (See Appendix C for the question by question document.) Two interviewers did not complete the training. Interestingly, and much to the supervisors' credit, the remaining 27 interviewers stayed with the study throughout the full data collection effort.

Beyond the refusal conversion and aversion training that took place at the training sessions, ongoing refusal conversion/aversion training occurred throughout the field period. Interviewers were also monitored regularly during the field period and offered feedback on their performance. Project management staff, telephone center supervisory and coordination staff, and Professor Miller, and Dr. Kimmel participated in the monitoring effort. Feedback that was thought to be of value to all the

interviewers was written up and disseminated by the supervisors. Weekly staff meetings with the interviewers were helpful in eliciting good cooperation techniques and observed data trends.

### **Data Collection Mode and Protocols**

The entire file of telephone numbers obtained from Survey Sampling, Inc. was loaded into the NORC Telephone Number Management System (TNMS), with a timed release of replicates. A flag was added to each record to indicate whether an advance letter was sent out to the household. Initially, a case was flagged as a "letter respondent" if an address was obtained from SSI, the sample vendor. These flags were revised regularly as mail was returned to the Chicago Academy of Sciences as undeliverable, indicating a letter was not received. This information was integrated with the CAT1 file to allow for a different introduction to be read to households that were sent letters versus households that were not.

The TNMS was designed to deliver cases to interviewers automatically, according to a preset algorithm for delivery of fresh cases plus cases in progress, and according to appointments as scheduled. In general, respondents were called between 5 p.m. and 9 p.m., respondent's local time during the week, and between 9 a.m. and 9 p.m. respondent local time on Saturdays, and between 10 a.m. and 9 p.m. respondent local time on Sundays.

### **Data Collection**

Data collection for this project consisted of three interrelated components: a mailing of advance letters, refusal letters, and postcards; a toll-free project information line; and actual telephone interview production. The data collection period ran from March 27 to August 5. No calling was done on Fridays due to its traditionally poor success. No calling was done on Mother's Day, Easter Sunday or Memorial Day. A respondent fee experiment was instituted in the later stages of the data collection and will be described separately below.

**Advance Mailing.** Advance letters describing the study were mailed in waves to respondents for whom we had addresses. Of the original 7,200 cases, 2,205 had names and addresses. The text of the letter was prepared by the Chicago Academy of Sciences and printed on Chicago Academy of Sciences letterhead (see Appendix D for letters and postcards mentioned in this section). NORC posted the letters with return addresses to the Chicago Academy of Sciences.

Mailings took place according to when sample replicates were released to the NORC telephone center. Staging the mailings helped to insure that a letter did not arrive at a household weeks before the first call attempt was made to the household. Similarly, one week was allowed for letters to arrive at a household before the first attempt was made to contact that household to avoid referring to a letter in the survey introduction that had not yet arrived at the household. (See page 14 for a discussion of replicate release dates.) Letters were also sent, using the advance letter text to respondents who asked for information to be sent about the study before they would participate.

Over the course of the advance mailing, 350 letters were returned. The Chicago Academy of Sciences staff forwarded information on the returned mail each week to NORC and the case files were adjusted to reflect that no letter was sent so that the correct preamble would appear on the interviewer's screen. In April it was decided to release two additional replicates. The letters in those replicates, a total of 248, were sent via Federal Express to ensure a rapid delivery.

Refusal letters, also prepared by the Chicago Academy of Sciences, were mailed to respondents for whom there was an address and for whom there was a soft refusal. (Addresses which were undeliverable were removed from the mailing.) On April 22, 479 refusal letters were sent via Federal Express with no signature required. Any addresses with post office box numbers were delivered by U.S. Priority mail. Each week thereafter any new cases with soft refusals, an additional 25 cases, were sent a conversion letter. A total of 504 refusal conversion letters were mailed.

Postcards were another type of mailing used on the study. Any cases with 14 non-contact attempts for which there was an address were sent postcards informing the respondent about the study and asking them to call the toll free number. The mailing consisted of 179 postcards.

**Toll-Free Information Line.** A toll-free telephone number was established at NORC as a mechanism to provide additional project information to potential respondents, and to allow individuals to suggest the best time to reach someone at home to complete an interview. This phone number was offered in the advance letter, and was also left on answering machines when messages were left (messages were left the third time a machine was reached at a household).

NORC project telephone center supervisory and coordination staff answered the 800 line. If the staff were not available respondents were prompted by a pre-taped script to leave a message. NORC Project personnel returned all calls within 12 hours.

Names and phone numbers of respondents who called the 800 line and desired to be contacted with study results were noted in the case file for fulfillment by the Chicago Academy of Sciences. The 800 line received a total of 118 calls from March through July 1999 (see Table 1).

**Table 1. Analysis of Logged Calls into CAS 800 Line.**

Type of Call	Number of Cases
I. R wanted to do interview	
A. Responding to letter	19
B. From message left on phone	25
C. Uncertain source	6
II. R wanted more information	4
III. R wanted to refuse participation	18
IV. R wanted to set appointment	25
V. R requested results	3
VI. R wanted promised money	1
VII. Phone number was a business	3
VIII. Reason cannot be determined	14
TOTAL CALLS	118

## Quality Control Procedures

Quality control procedures were in place throughout the study and across all tasks. Key to assuring quality data was attention to communication. Communication between the Chicago Academy of Sciences staff and various NORC work groups occurred daily during the early stages of the study and, minimally, weekly meetings were held with the telephone shop supervisors, the mail shop supervisors and the Information Services programming manager and staff. **Early** review of the data by Professor Miller and Dr. **Kimmel** offered the opportunity for feedback and training corrections to the telephone staff across all the interviewers when appropriate and at the individual level. For example, in the verbatim responses, Dr. **Kimmel** reviewed the key words and their correct spellings throughout the data collection to assure that these critical responses were of high quality. Periodic debriefings were held with the interviewers to discuss and share refusal conversion tactics. The ongoing telephone monitoring of interviewers was also very important to maintaining standardized approaches to the data collection. When refusal conversion efforts were initiated a meeting was held with the interviewers preparing them for this next phase of data collection.

Time zone reports were produced weekly and reviewed to assure that each zone was receiving the correct proportion of call attempts. As seen in Table 2, the Alaskan time zone had a disproportionate number of out of scope cases that reduced its percentage of completion. Out of scope cases include sample where phones were disconnected, cell phones, business or dormitory numbers, second numbers in a household, phone problems, and numbers not associated with a residence (continuous ring-no-answers).

**Table 2. Out of Scope Cases by Time Zone.**

	Eastern		Central		Mountain		Pacific		Alaska		Hawaii	
Completes:	874	26%	642	26%	83	29%	277	25%	4	12%	4	21%
Out of Scope:	1651	50%	1275	56%	148	52%	563	52%	22	67%	12	63%
Total Dialed Sample:	3327		2247		286		1088		33		19	

In other areas:

- Monitoring reports were reviewed to assure that each interviewer received the appropriate number of monitoring sessions.
- Hours per case reports were produced weekly at the interviewer level and across the project.
- Frequencies of the first two weeks of data were reviewed.
- A log of all 800 calls and their outcomes was maintained.
- For mailings, "dummy" letters were posted to central office staff to gauge the delivery time and confirm the mailings.
- A log of procedural changes and staff memos was maintained.

A log of any procedural changes and Chicago Academy of Sciences queries and responses was maintained by NORC staff.

Data were posted weekly to a secured FTP Web site which avoided e-mail attachments which could be corrupted in transmission. The FTP security is based on the Microsoft Internet Server and uses the security features of the operating system. An IP address with access restrictions was used.

Several reports were run on a daily or weekly basis to monitor quality and to produce data to support management decisions:

Hourly case delivery reports were reviewed by NORC staff to assure that the correct number of calls for the number of interviewers staffed was correct.

Pending Call Count /Calls to Finalization Report was produced and reviewed by NORC staff. Case completion quotas were set for the shifts of interviewers as well as at the interviewer level.

Replicate Reports that detailed the timing and number of cases released as well as providing cross tabs of replicate by disposition code were produced and reviewed by NORC staff.

- Case Age Reports were reviewed by NORC staff and aging cases had the call notes reviewed for action plans.
- Time Zone Reports were reviewed by NORC staff to assure that each zone was receiving the correct proportion of call attempts.
- Monitoring Reports were reviewed by NORC staff to assure that each interviewer was monitored for the correct amount of time over the period of data collection.
- Interviewer Reports displayed the hours worked and the productivity of the individual interviewers and were reviewed by NORC staff.
- Ongoing Chicago Academy of Sciences review of data included verbatim responses for completeness and readiness for coding. Completeness of responses for Industry and Occupation coding were also reviewed. Corrections and instructions were given to the interviewers based on findings by the Chicago Academy of Sciences staff.
- Letter Request File reports were produced and reviewed by NORC staff. These reports pointed out the need for retraining in cases where the respondent requested a letter explaining the study but the interviewer did not capture an address.

### **Sampling Errors and Design Effects**

The standard error of the proportion is given by the equation:

$$s_p = \sqrt{p(1-p)/N}$$

where: p = the proportion of the sample with a given characteristic; and  
N = the sample size.

Once the standard error has been calculated, one can develop a 95 percent confidence interval for any given proportion within the sample based on  $\pm 2$  standard errors. For the sample as a whole, the standard errors for any given proportion are small (see Table 3). Table 3 also provides the standard errors for the



major analytic subgroups within the sample, based on different proportions of the sample (or subgroup) having a selected characteristic. The SSI random-digit sample is not clustered and, therefore, has no design effect.

True simple random sampling will produce a self-weighting sample of elements. In practice, the **self-weighting** feature is destroyed by non-response. Kalton (1983) comments that,

The cause of concern about non-response is the risk that non-respondents will differ from respondents with regard to the survey variables, in which case the survey estimates based on the respondents alone will be biased estimates of the overall population parameters (p. 63).<sup>2</sup>

Lee, Forthofer, and Lorimor (1989) discuss the methods typically used to reduce bias introduced by **non-response**. They note that there are,

Two methods employed in an attempt to reduce the bias are post-stratification and **non-response** adjustments. Post-stratification involves assigning the weights to bring the sample proportion in demographic groups into agreement with the population proportion in the subgroups. Non-response adjustments inflates the weights for those who participate in the survey to account for the non-respondents with similar characteristics (pp. 13-14).<sup>3</sup>

A weight variable, WT5, was constructed to account for non-response (see pages 23-24 for further information about WT5). The data was weighted by WT5 for all analyses and tabulations conducted for the study. It should be noted that the use of a post-stratification weight to adjust for non-response assumes that the non-respondents from any given subgroup are missing at random **from** that subgroup with regard to the survey variables.

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<sup>2</sup> For further information, see Kalton (1983), *Introduction to Survey Sampling*. Newbury Park: Sage Publications.

<sup>3</sup> For further information, see Lee, Forthofer, and Lorimor (1989). *Analyzing Complex Survey Data*. Newbury Park: Sage Publications.

**Table 3. Standard Errors for Subgroups with Selected Characteristics.**

	--Percentage of Sample with Characteristic--									
Sample Group	5/95	10/90	15/85	20/80	25/75	30/70	35/65	40/60	45/55	50/50
Total sample (N=1,882)	.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Gender										
Men (N=900)	.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
Women (N=981)	.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
Highest level of education										
Less than high school (N=403)	.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03
High school graduate (N=1,111)	.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
Baccalaureate degree (N=239)	.01	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Graduate degree (N=129)	.02	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Age										
18 through 24 (N=263)	.01	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03
25 through 34 (N=440)	.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
35 through 44 (N=395)	.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
45 through 64 (N=487)	.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
65 and older (N=296)	.01	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03
Attentive public for science and technology										
Attentive public (N=216)	.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Interested public (N=836)	.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02
Residual public (N=830)	.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02